

Computational details for the paper (Part 3): “Application of benchmark analysis for mixed contaminant exposures: Mutual adjustment of perfluoroalkylate substances associated with immunotoxicity”

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Introduction

This document contains computational details of results in two tables of Budtz-Jørgensen and Grandjean (2018). Thus, we provide SAS output in Table 1 & 2. This document is a supplement to similar reports from 2020 and 2022. This report is focused the effect of PFOA in a piecewise linear model without and with adjustment for PFOS.

SAS output

The following pages show SAS-output from the two SAS-programs provided in section *SAS programs*. The output is from regression models with corresponding BMD results. The regression models are run with the procedure PROC REG in SAS. In the regression results, the exposure coefficients is always called *d1 and d2 (d1 is the slope below the median, d2 is the slope above the median)*. In the title of the output (line 1) the exposure variable is given. We provide results for the diphtheria concentration as for this outcome the piecewise linear model was significantly better than a linear model.

Variable names

- ltet51: log2 of tetanus concentration at age 5
- ldif51: log2 of diphtheria concentration at age 5
- sex: childs sex
- age5a: age at 5 year examination
- cohort5: binary variable allowing for difference between cohorts
- vsex: interaction term between cohort and sex
- vage: interaction term between cohort and age
- matpfos: maternal concentration of PFOS
- matpfoa: maternal concentration of PFOA
- lmatpfos: log2 maternal concentration of PFOS
- lmatpfoa: log2 maternal concentration of PFOA

Model without adjustment for PFOS

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The REG Procedure

Model: MODEL1

Dependent Variable: ldif51

Number of Observations Read	900
Number of Observations Used	853
Number of Observations with Missing Values	47

Analysis of Variance

Source	Sum of Squares		Mean Square	F Value	Pr > F
	DF	Squares	Mean Square	F Value	Pr > F
Model	7	123.32662	17.61809	4.55	<.0001
Error	845	3268.51055	3.86806		
Corrected Total	852	3391.83717			

Root MSE	1.96674	R-Square	0.0364
Dependent Mean	-3.09935	Adj R-Sq	0.0284
Coeff Var	-63.45645		

Parameter Estimates

Variable	Label	Parameter		Standard	t Value	Pr > t
		DF	Estimate	Error		
Intercept	Intercept	1	0.97145	7.54641	0.13	0.8976
d1		1	-0.49460	0.16346	-3.03	0.0026
d2		1	0.02944	0.08496	0.35	0.7290
sex		1	-0.55906	0.17465	-3.20	0.0014
AGE5A	Age, first 5yr exam	1	-0.53579	1.52169	-0.35	0.7249
cohort5		1	17.67949	11.16809	1.58	0.1138
vsex		1	0.95529	0.27667	3.45	0.0006
vage		1	-3.68854	2.23403	-1.65	0.0991

Parameter Estimates

Variable	Label	DF	90% Confidence Limits	
Intercept	Intercept	1	-11.45490	13.39781
d1		1	-0.76376	-0.22544
d2		1	-0.11046	0.16935
sex		1	-0.84665	-0.27147
AGE5A	Age, first 5yr exam	1	-3.04149	1.96992
cohort5		1	-0.71054	36.06952
vsex		1	0.49971	1.41087
vage		1	-7.36723	-0.00986

Model with adjustment for PFOS (term lpfosmat)

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The REG Procedure

Model: MODEL1

Dependent Variable: ldif51

Number of Observations Read	900
Number of Observations Used	853
Number of Observations with Missing Values	47

Analysis of Variance

Source	Sum of		Mean		
	DF	Squares	Square	F Value	Pr > F
Model	8	137.45179	17.18147	4.46	<.0001
Error	844	3254.38538	3.85591		
Corrected Total	852	3391.83717			

Root MSE	1.96365	R-Square	0.0405
Dependent Mean	-3.09935	Adj R-Sq	0.0314
Coeff Var	-63.35669		

Parameter Estimates

Variable	Label	Parameter		Standard	
		DF	Estimate	Error	t Value
Intercept	Intercept	1	2.77727	7.59339	0.37 0.7146
d1		1	-0.34729	0.18044	-1.92 0.0546
d2		1	0.06587	0.08694	0.76 0.4488
sex		1	-0.58063	0.17474	-3.32 0.0009
AGE5A	Age, first 5yr exam	1	-0.68939	1.52142	-0.45 0.6506
cohort5		1	15.63538	11.20156	1.40 0.1631
vsex		1	1.01025	0.27772	3.64 0.0003
vage		1	-3.35661	2.23725	-1.50 0.1339
lpfosmat		1	-0.29666	0.15500	-1.91 0.0560

Parameter Estimates

Variable	Label	DF	90% Confidence Limits	
Intercept	Intercept	1	-9.72646	15.28100
d1		1	-0.64442	-0.05017
d2		1	-0.07728	0.20903
sex		1	-0.86837	-0.29289
AGE5A	Age, first 5yr exam	1	-3.19465	1.81586
cohort5		1	-2.80979	34.08055

vsex	1	0.55294	1.46757
vage	1	-7.04061	0.32738
lpfosmat	1	-0.55189	-0.04143

